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TERRACING FARM LANDS

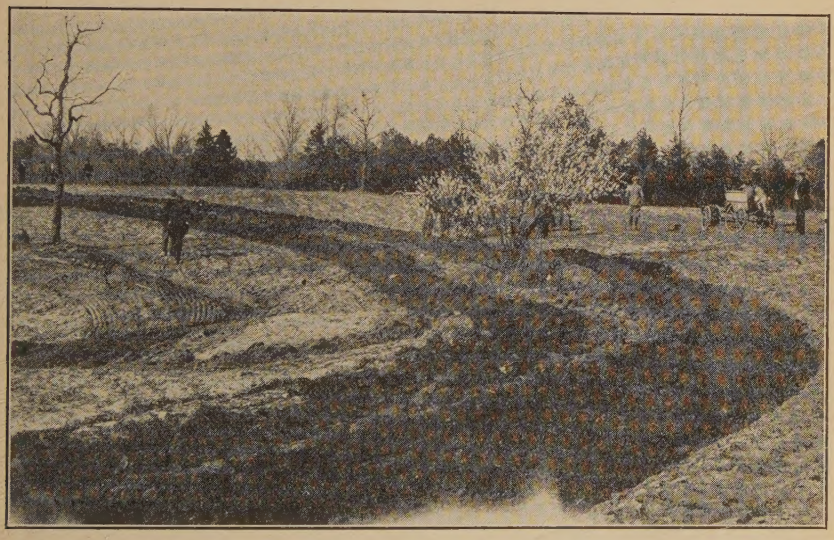

Figure 1—A GOOD TERRACE. This terrace is nearly completed as shown by the good height and width. It was built with two tractors, a disc plow and a Martin ditcher. Observe erosion actions below the peach tree. Davidson County, N. C., 1926.

NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING
AND
U. S. DEPARTMENT OF AGRICULTURE, COOPERATING
N. C. AGRICULTURAL EXTENSION SERVICE
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STATE COLLEGE STATION
RALEIGH

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TERRACING FARM LANDS

By A. T. HOLMAN, *Extension Agricultural Engineer.*

There are two kinds of erosio: Sheet Erosion and Gullies. Gullies (Figure 2) are readily seen. Destructive effects of gullies can be seen over all parts of North Carolina except on very flat areas of the Coastal Plain. Sheet Erosion—the removal of a small depth of soil from the entire field—is equally destructive. Large amounts of soil are eroded from spaces between cotton, corn and tobacco rows where small gullies are formed.

In North Carolina 88 per cent of our erosion occurs during the months of June, July, August and September. The top-soil in our cotton and tobacco fields will be washed away in less than 50 years if not protected. Grass sod will prolong the life of the soil to several thousand years. Grow grass or timber on the steeper slopes. Cultivated land on slopes can be saved in only one way. Terrace your fields—build Mangum Terraces. Gullying can be controlled by using soil saving dams.

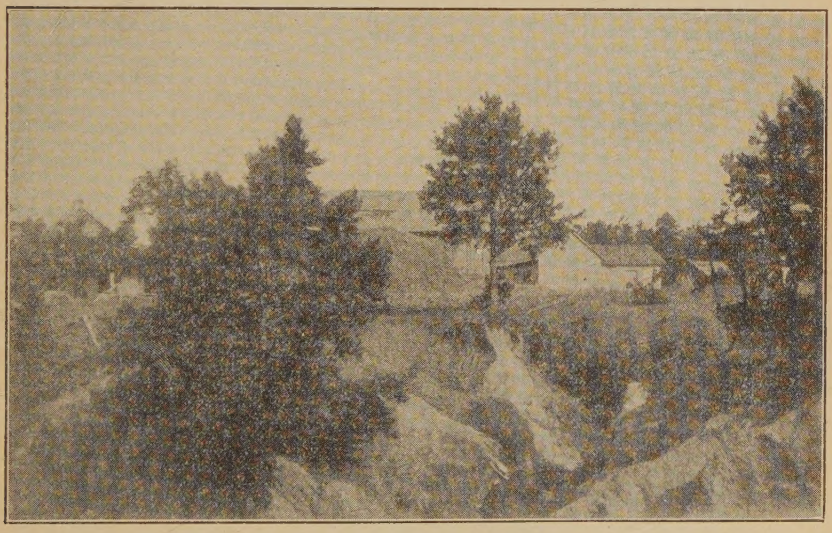

Figure 2—GULLY EROSION. This gully is 20 feet deep, 50 feet wide and ½ mile long. At its present rate of growth it will soon undermine the farm buildings. SOIL SAVING DAMS will reclaim it. Guilford County, 1928.

The Mangum Terrace is the best known means of controlling erosion on North Carolina farms. The Mangum Terrace (Figures 1, 3 and 4) is a broad bank of earth behind which water flows with a gentle fall and low velocity to some suitable outlet.

Each field has its own peculiar problems, but the following rules may be considered a practical guide for locating and constructing terraces on North Carolina farms.

TEN RULES FOR SUCCESSFUL TERRACING

Rule 1—Outlets: Consider the future development of uncultivated land in selecting outlets. Good outlets are: Pastures, timber lands and streams. Other satisfactory outlets are: Natural draws, roadside ditches, fence rows and artificial ditches at property lines. Outlets must slope away from the terraced field. Protect terrace outlets from erosion. Don't permit a gully to form at the terrace outlet.

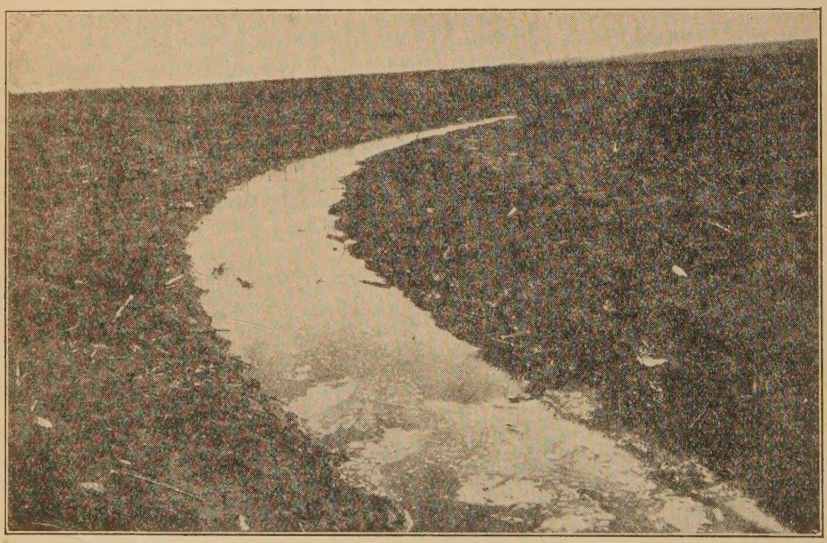

Figure 3—MANGUM TERRACES CHECK EROSION by controlling the flow of water permitting it to pass off the field in a wide shallow stream having a slow rate of flow. Wake County, 1927.

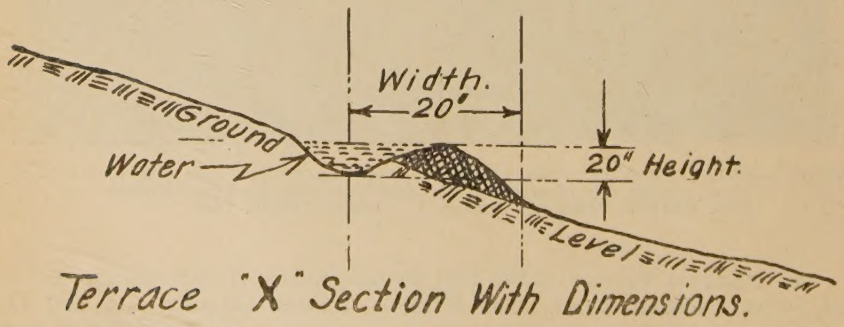

Figure 4—MANGUM TERRACE. There are many kinds of "so called" terraces, but this illustration shows the Mangum Terrace which is 20 feet wide and 20 inches high. This is the terrace recommended for North Carolina farms.

Rule 2—Location: In locating terraces use a telescope level (Figures 5 and 6). Locate the top terrace first. Stake terrace line every 50 feet (17 paces). On rough lands where terraces have sharp bends set stakes every 25 feet. Mark each line with a plow furrow, eliminating sharp bends, before leaving the field.

Figure 5—FIRST TERRACING SCHOOL. Six farmers were taught how to locate terraces using the telescope levels shown in the picture. The Terracing School replaces the demonstration as an extension method used to teach farmers how to locate and build good terraces. Franklin County, 1926.

Figure 6—TWENTIETH TERRACING SCHOOL. Here farmers and farm boys received definite instructions in locating terraces with the telescope level. Pencils and notebooks are used to calculate proper spacing of terraces. Granville County, 1928.

Rule 3—Spacing: Spacing is the "distance apart" determined by the drop (difference in elevation) between any two successive terraces. Space all terraces according to Table No. 1.

TABLE 1.—*Vertical Distance (drop) Between Terraces*

Slope of Land per 100 Feet*	Vertical Distance (drop) Between Terraces
Feet	Feet
2	2½
3	3
5	3½
7½	4
10	4½
12½	5

* Measure slope of land by taking the difference in rod readings at two points 100 feet apart (Figure 7)—the lower rod reading taken directly down the slope from the upper one.

Rule 4—Fall or Grade and Length: Never give a terrace more than 6 inches fall in 100 feet lengths. Long terraces require a **variable grade** (Figure 16). Grade terraces according to Table No. 2.

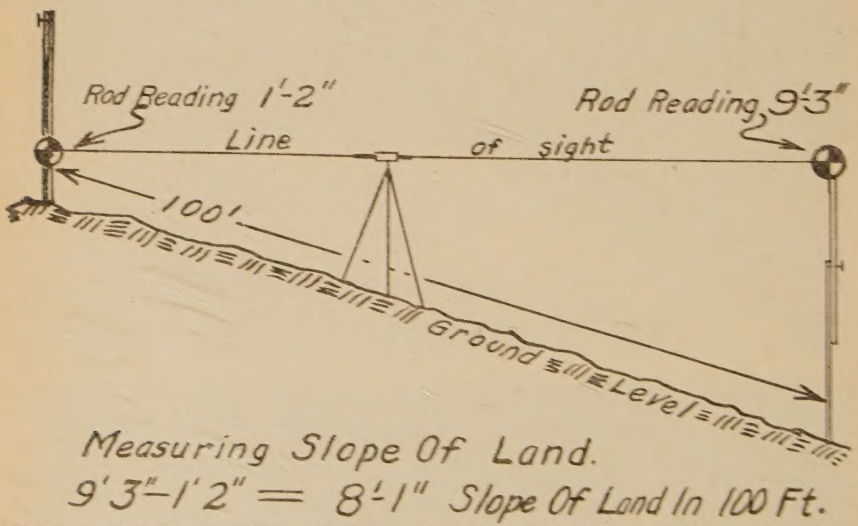

Figure 7—MEASURING SLOPE OF LAND. The slope of land is measured to determine the proper spacing for terraces. The leveling instrument on the tripod is leveled then rod readings as illustrated are taken. The smaller rod reading subtracted from the larger one gives the slope of land.

TABLE 2.—*Fall in Inches Per 100 Feet for Mangum Terrace*

Distance from Outlet	Fall in Inches per 100 Feet
0 to 300 feet	6 inches
300 to 600 feet	4 inches
600 to 900 feet	2 inches
900 to 1200 feet	1 inch
1200 to 1500 feet	½ inch

NOTE:—See Part II for detailed procedure in spacing and locating terraces.

Table 3.—*Target Settings in 50 Foot Intervals for Laying Off Mangum Terraces with Variable Grades*

Distance from Outlet (Feet)		Grade Change of Target (Inches)	Total Fall (Ft.—Inches)
0		0	0—0
50		3	0—3
100		3	0—6
150		3	0—9
200		3	1—0
250		3	1—3
300	Change of Grade	3	1—6
350		2	1—8
400		2	1—10
450		2	2—0
500		2	2—2
550		2	2—4
600	Change of Grade	2	2—6
650		1	2—7
700		1	2—8
750		1	2—9
800		1	2—10
850		1	2—11
900	Change of Grade	1	3—0
950		½	3—½
1000		½	3—1
1050		½	3—1½
1100		½	3—2
1150		½	3—2½
1200	Change of Grade	½	3—3
1250		¼	3—3¼
1300		¼	3—3½
1350		¼	3—3¾
1400		¼	3—4
1450		¼	3—4¼
1500		¼	3—4½

1500 feet longest terrace recommended.

Rule 5—Width: New terraces, on lands of average slope, should be 20 feet wide at the base (Figure 4). Settled terraces should not be less than 16 feet wide.

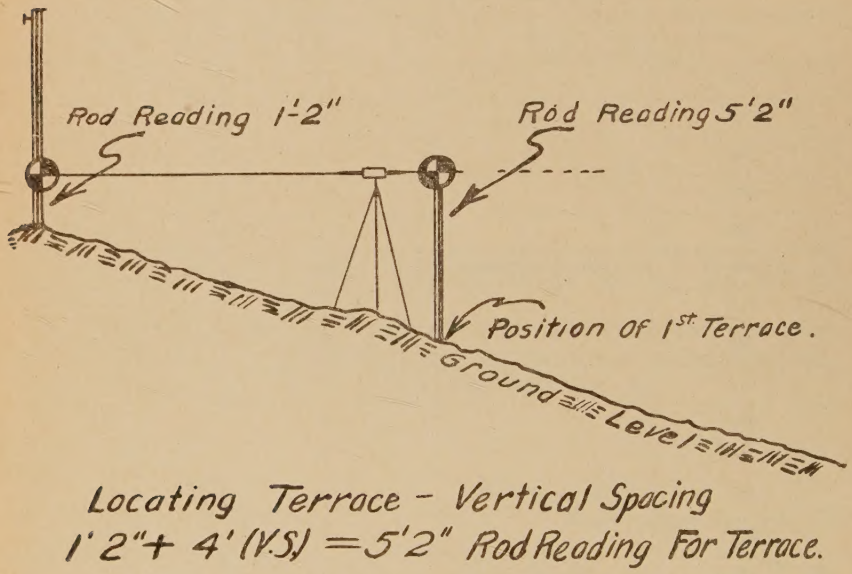
Rod Reading 1'-2"
Rod Reading 5'2"
Position of 1st Terrace.
Ground Level
Locating Terrace - Vertical Spacing
1'2" + 4' (V.S.) = 5'2" Rod Reading For Terrace.

Figure 8—LOCATING FIRST TERRACE. The vertical spacing added to the smaller rod reading for locating first (or next) terrace. In this example the smaller rod reading is 1 ft. 2 in. and the vertical spacing is 4 ft. 0 in. Adding these figures gives 5 ft. 2 in. rod reading for locating first terrace.

Rule 6—Height: The top of the new terrace should be 20 inches higher than the water channel (Figure 4). After the earth becomes packed the minimum height should be 15 inches. Keep low place in terrace lines built up to desired height.

Rule 7—Construction: Construct top terrace first. Do not begin Terrace No. 2 until Terrace No. 1 is completed—20 feet wide at base and 20 inches high at crown. The center line of the terrace should be about three feet below (down the hill from) line of stakes. Use the best equipment available. A good terrace can be built by a good plow and persistent efforts (Figure 9). However(the use of tractors, good ditchers, drags and grades is advisable (Figure 10).

One two-horse plow, team and driver, and one home-made V-shaped terracing grader, team and driver are found satisfactory (Figures 11 and 23). With this equipment the plow throws the soil from both sides toward the center of the terrace. The drag or grader is reversible and works on the upper side of the terrace only moving loose soil from the water channel (above the terrace) and banking it on the terrace crown. Following this plan build the terrace first to the desired height (20 inches) and second to the proper width (20 feet).

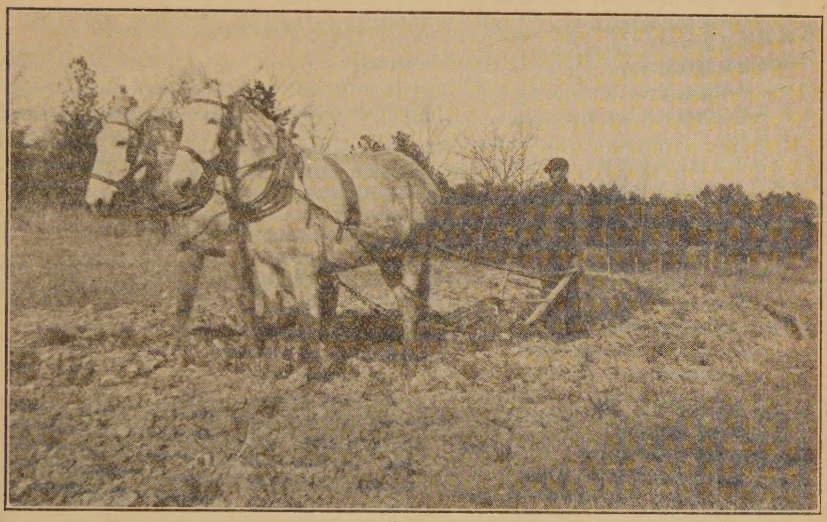

Figure 9—THE FIRST PLOWING COMPLETED. A good terrace can be built with a plow but a good drag will save time and make a better job. Halifax County, 1928.

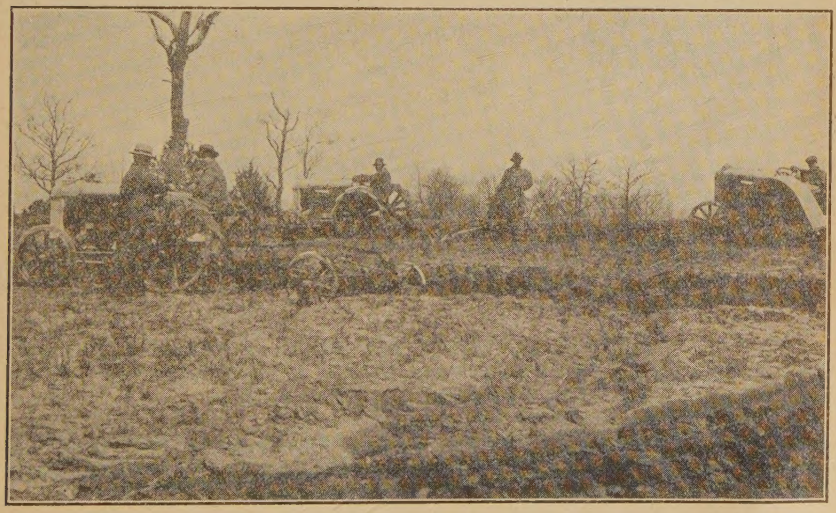

Figure 10—GOOD EQUIPMENT BUILDS TERRACES RAPIDLY. The tractor and disc plow begin another terrace while the other tractor and ditcher complete the former one. Davidson County, 1926.

In terracing a farm it is advisable to locate and build one or two terraces near the top of each field the first year; the second year build the next lower ones rather than completely terracing one field each year.

Rule 8—Gullies: Cross gullies directly. Reinforce terrace line with a dam high and wide enough so that it will not break at times of heavy rain. The use of a slip fresno or wheel scraper is advisable for building earth dams across gullies, removing high places from the water channel and filling low weak places on the terrace crown. Erosion in large gullies used for terrace outlets may be checked by using a soil saving dam (Figure 13).

Rule 9—Maintenance: Check new terraces frequently. Keep them 15 to 20 feet wide and 15 to 20 inches high. No breaks will occur if terraces are checked and repaired before rains.

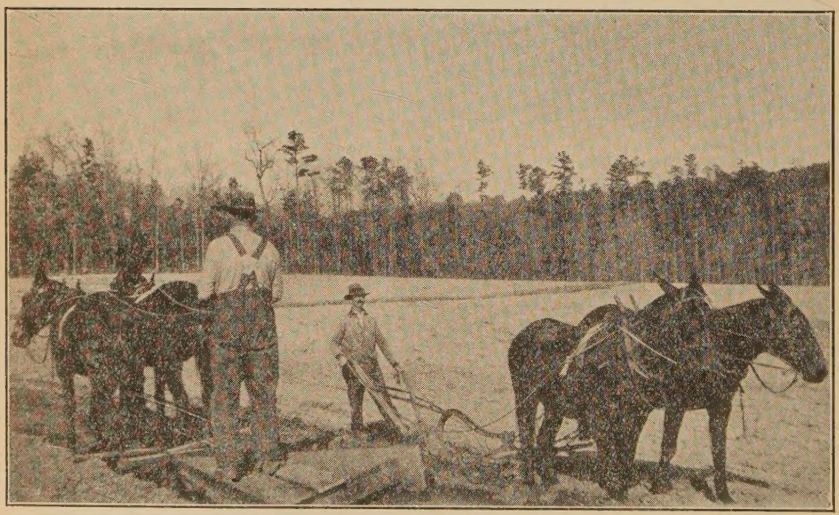

Figure 11—PLOW AND "V" DRAG. This equipment is suitable for building a good terrace. The plow works on both sides of the terrace, but the drag moves soil from the upper side only. Montgomery County, 1928.

Crop rows should run in contours parallel to terraces the first year or two (Figures 14 and 15) until the terraces become firm. Afterwards, farm operations and crop rows may cross terraces.

In planting parallel to terraces, usually one or more short rows will be found between each pair of terraces. This is due to irregular slopes of land. It is advisable to begin rows parallel to the higher terraces (Figure 15). Continue uniform spacing of crop rows as farm operations proceed toward the next lower terrace until reaching the water channel. Let all short rows be parallel to the long ones. Each short row will end at some point on the water channel. One crop row should be placed on the upper side of the terrace between the crown and water furrow.

Rule 10—Cost and Value: Good terraces pay well: Poor terraces do more harm than no terraces at all.

Cost of building terraces vary. No definite cost figures are available. On an average it takes about the same length of time to terrace an acre as it takes to plow an acre. That is—two teams that would plow 3 acres per day should build about 2000 feet of terraces in the same time.

Terrace values vary. However, the following interesting figures are average estimates of 28 farmers who have 1357 acres terraced:

Value of fertilizer saved per acre each year	$ 6.25
Increased crop value per acre each year	5.75
Increased land value per acre	20.00

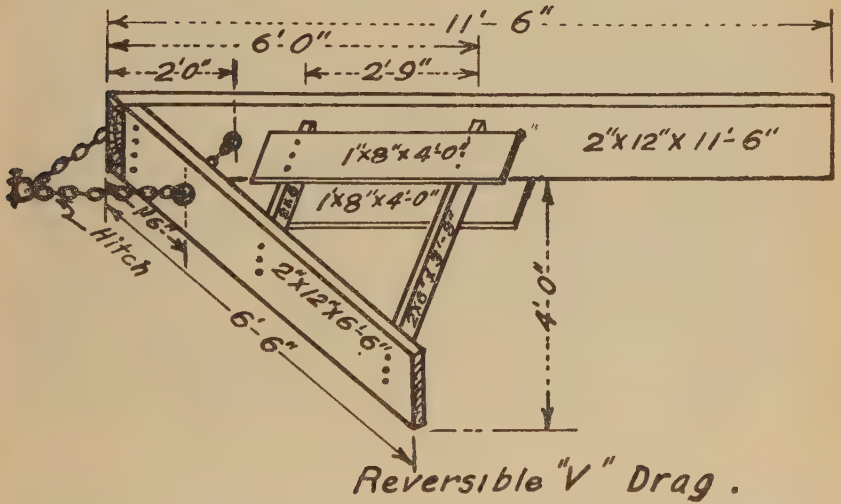

Figure 12—THE HOME-MADE "V" DRAG is inexpensive and easily made. In building a terracing drag follow the dimensions given. Hitch the team so that the drag will operate in a straight line parallel with the terrace.

TERRACING—SELF-TAUGHT

A definite procedure recommended for one to learn to terrace is given in the following twenty steps. These steps serve as a complete and definite guide useful for both those who may be learning terracing under an instructor and those who are learning without an instructor.

LAYING OFF TERRACES—PROCEDURE

Step 1—Learn how to use the terracing level by studying the instructions accompanying it.

Step 2—Provide necessary equipment and assistance including one farm level (Figures 5 and 6), rod and target, stakes and three men.

Figure 13—A SOIL SAVING DAM. Gullies may be controlled by using a soil saving dam. This concrete dam is 100 feet long and 3 to 7 feet high. Gaston County, 1927.

Step 3.—Go toward the top of the hill—near the highest point in the field. (Figure 7.)

Step 4—Set up the leveling instrument midway between the ends of the uppermost terrace and high enough so that when the instrument is leveled the line of sight will pass over the highest point in the field. (Figure 7.)

Step 5.—Have rodman hold rod on highest point in the field: record rod reading. (Figure 7.)

Step 6—Have rodman pace 100 feet (33 paces) straight down the hill. Take the second rod reading here. (Figure 7.)

Step 7—Subtract rod reading No. 1 (smaller) from No. 2 (large). The difference in these rod readings gives you the slope of the land per 100 feet. (Figure 7.)

Figure 14—CROP ROWS PLANTED PARALLEL TO TERRACES. Terraces on this nursery farm are estimated to save $3000.00 worth of soil and plant food annually. Catawba County, 1928.

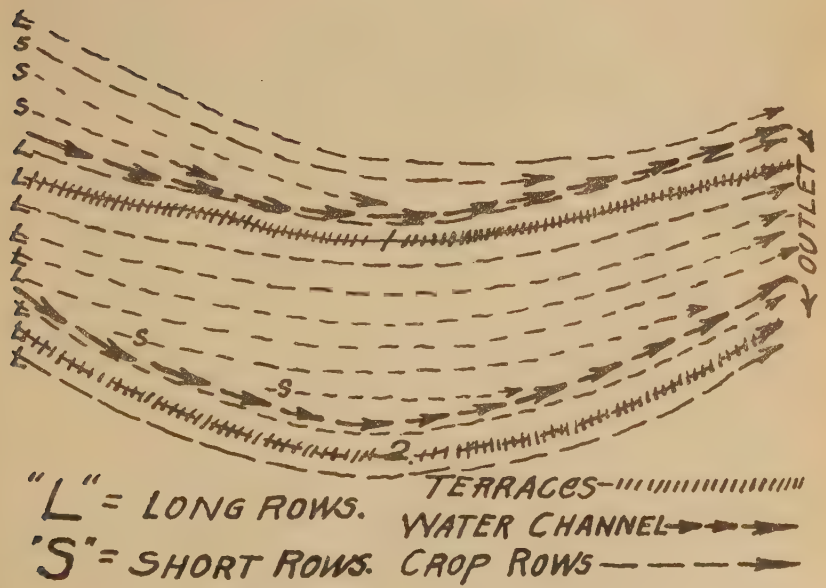

Figure 15—CONTOUR PLANTING. Crop rows should be planted parallel to all new terraces. A good plan is to begin rows parallel to the higher terrace and continue laying off rows until the next lower terrace is reached. Have short rows between the long rows and the water furrow of the lower terrace. Each short row ends at the water furrow.

Step 8—Refer to Table No. 1—Rule 3. In the first column (under slope of land per 100 feet) select the figure closest to the slope of land figure you found in Step 7. Then read the number in column two—directly opposiite to figure selected in column one—this figure (obtained from column 2) is the vertical spacing (drop) between terraces.

Step 9—Add vertical spacing to first rod reading (at top of hill) (Figure 8). The sum of these gives the rod reading for locating Terrace No. 1.

Step 10—Have rodman set target according to step 9 and move up or down the hill until the line of sight (Figure 8)—looking through the telescope—cuts the center (horizontal) line of the target. This is the reference point for Terrace No. 1. Set a stake here and make a record of the rod reading.

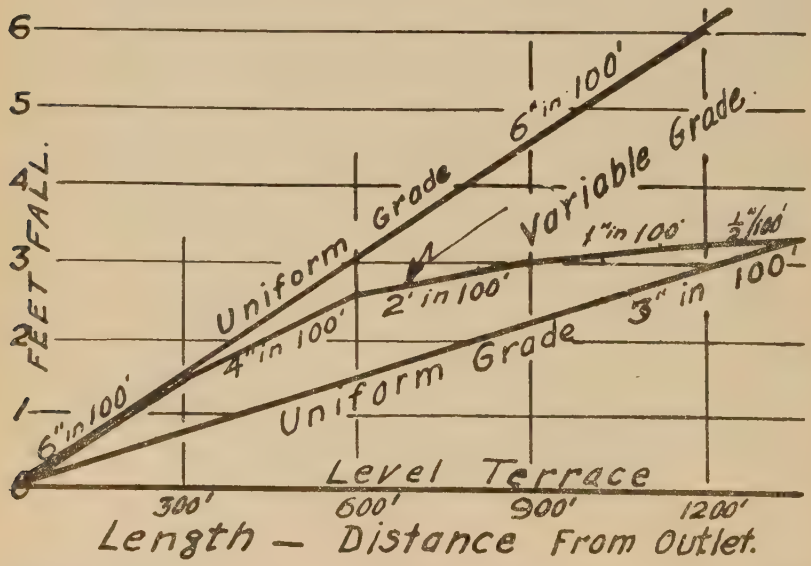

Figure 16—FALL AND LENGTH OF TERRACES. Level terraces have no fall. Uniformly graded terraces have the same degree of fall on all parts of the terrace line. Variable grade terraces have a slight grade at the upper end which increases (at each 300 foot interval) as the outlet is approached.
Variable grade terraces are recommended for most fields.

Example: Showing Calculation of Foregoing Steps (5-10)

Step 6—Rod reading 100 feet down slope from top of field . 9 ft. 3 inches

Step 5—Rod reading at top of field . . . . . 1 ft. 2 inches

Step 7—Difference in rod reading (slope of land) . . . . . 8 ft. 1 inches

Step 8—From Table No. 1 in column 1 read 7½; and opposite in column 2 read 4 feet vertical drop.

Step 9—Add—rod reading at top of field.....1 ft. 2 inches
and the vertical drop.....4 ft. 0 inches

The sum gives the rod reading for locating
Terrace No. 1.....5 ft. 2 inches

Step 10—Set target at 5 feet 2 inches and locate reference point.

Note 1—All successive terraces are similarly located.

Note 2—If land is too steep to get slope in 100 feet then get slope in 50 feet and multiply by 2.

Step 11—Determine approximate location of outlet by looking through the telescope sighting on some object (fence post, telephone pole, building or tree) that is seven to eight feet above the ground.

Step 12—Estimate distance from outlet to reference point.

Step 13—From Tables No. 2 and No. 3—Rule 4—determine proper grade at reference point.

Example and Explanation: If the distance from the reference point to the outlet is 650 feet, the target will be moved up one inch (from Table No. 3) for locating first station toward outlet.

Rod reading at reference point.....5 ft. 2 inches
Fall in 50 feet (600-650 feet from outlet).....0 ft. 1 inch

Rod reading for first station toward outlet .....5 ft. 3 inches

Step 14—With the target set at the proper rod reading (in this example 5 ft. 3 in.) have rodman take 17 paces (50 feet) from reference point toward outlet. Direct him to move the rod up or down the hill until the line of sight through the instrument strikes the center of the target. The ground on which the rod now rests is one inch lower than the reference point. Place a stake here. This is the second point on the terrace.

Step 15—Change target to next rod reading (in this example 550 to 600 feet from outlet it will be moved up two inches (from table No. 3) making the rod reading 5 ft. 5 in. for locating next point). Move rod up or down the hill until cross hair of instrument strikes center of target. Set stake here. This is the third point on the terrace.

Step 16—Continue in a similar manner proceeding toward outlet changing target (according to Tables No. 2 and No. 3) and locating the terrace every 50 feet until the outlet is reached.

Step 17—After completing the lower end of the terrace—from reference point to the outlet-return to the reference point to locate the upper end of the terrace. The first rod reading from the reference point toward the upper end of the terrace will be (in this example) one inch less than the rod reading at the reference point (see Table No. 3—Rule 4—700 feet from the outlet). The rod will read 5 feet 1 inch.

Example and Explanation of Step 17: If the distance from the reference point to the outlet is 650 feet the target will be moved down one inch (from Table No. 3—Rule 4) for locating first station toward the upper end of the terrace. Calculation for this procedure follows:

Rod reading at reference point .....5 ft. 2 in.
Fall in 50 feet (650 to 700 feet from outlet).....0 ft. 1 in.

Subtract. The difference gives the rod reading .....5 ft. 1 in. for first station toward upper end of terrace.

Step 18—Have rodman set the target at the proper reading (in this example—5 ft. 1 inch). Direct him to take 17 paces from the reference point toward the upper end of the terrace where he moves the rod up or down the hill until the line of sight through the instrument strikes the center of the target. Set a stake here.

Step 19—With similar procedure locate and mark successive points at 50 foot intervals on the upper part of the terrace until reaching the end (highest point).

Note 1—Remember that the rod reading is less at the upper end of the terrace than it is at the reference point.

Note 2—Remember that the rod reading is greater at the outlet than at the reference point.

Note 3—If the terrace in the foregoing example is 1200 feet long the rod will have respective readings as follows:
At the outlet .....7 ft. 9 inches
At the reference point.....5 ft. 2 inches
At the upper end .....4 ft. 6 inches

Note 4—Subtracting 4 ft. 6 in. from 7 ft. 9 in. gives 3 ft. 3 in. the total fall from the upper end to the outlet—in a distance of 1200 feet. Check this with Table No. 3—Rule 4.

After completing the first terrace (locating and staking both ends) you are ready to get the proper spacing for the next lower terrace.

Step 20—To locate the second terrace follow steps 5, 6, 7, 8, 9 and 10 in the same manner followed in locating the first terrace. In locating the second terrace use the reference point of Terrace No. 1 for the highest point (smaller rod reading) instead of using the highest point in the field. Measure slope of land, consult Table No. 1—Rule 3 to get the proper vertical spacing (drop). Add vertical spacing to rod reading at reference point on first terrace to get reference point on the second terrace.

Note 1—After completing the first terrace it is usually necessary to move and level the terracing level about seventy-five feet down the hill before the spacing of second terrace can be determined.

Note 2—Calculations and procedures used in all successive terracing efforts are similar to the foregoing examples and outline.

GENERAL DISCUSSION OF MISCELLANEOUS TERRACING FACTORS

1—Length and grades of terraces: Tables No. 2 and No. 3 under rule 4 give **variable grades** for all mangum terraces not exceeding 1500 feet in length. Don't make a terrace longer than 1500 feet unless you provide outlets at both ends. This makes two terraces. (Figure 17, Terrace No. 2.)

Long Terraces are 900 to 1500 feet in length. Always use the **variable grades** for locating long terraces.

Short Terraces are less than 900 feet in length. Short Mangum Terraces may have either uniform or variable grades (fall) (Figure 16). Variable grades are recommended. However, a **uniform fall** of four or six inches in 100 feet may be used successfully instead of a variable grade for short terraces (if the terraces are spaced, located and built properly.

2—Level Terraces have no fall (Figure 16). All points on the terrace line have the same elevations (Figure 17, Terrace No. 1). In locating level terraces the target is never moved; the rod reading remains the same at the outlet, reference point, upper end of the terrace and at all intermediate points.

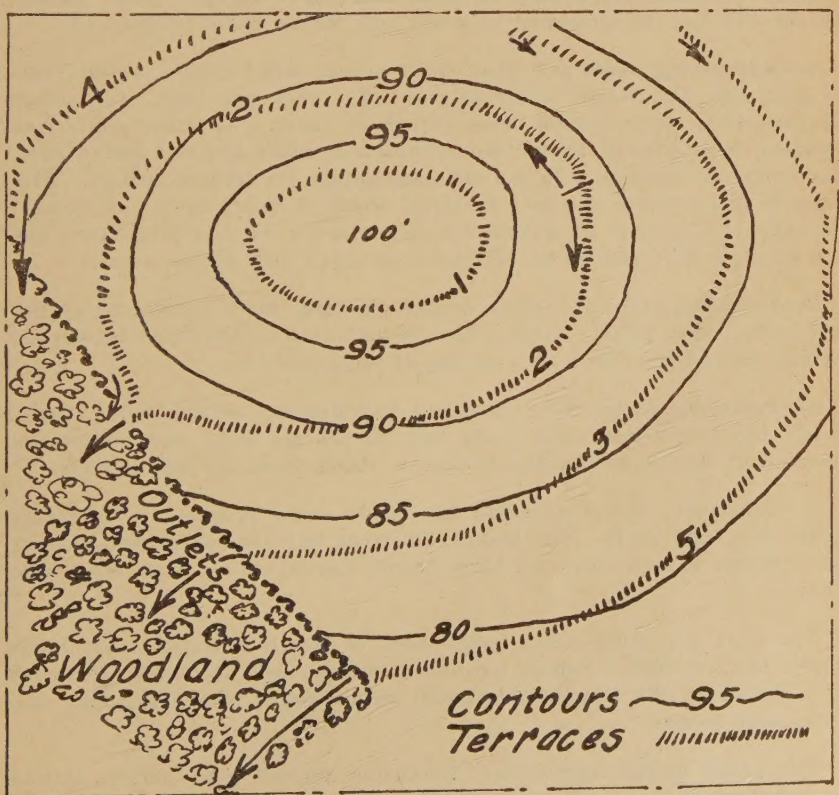

Figure 17—A TYPICAL KNOLL SHOWING TERRACES, OUTLET AND CONTOURS. Terrace No. 1 is a level terrace surrounding the knoll. Terrace No. 2 is divided making two terraces (note that graded terraces cross contour lines while level terraces follow or parallel contours).

Level Terraces have been used and may be used under the following conditions:

(a) **Near the top of knolls** (Figure 17, Terrace No. 1) where there are no natural outlets—the ends of the terrace are joined.

(b) **On light porous soils** where the conservation of moisture is desirable.

(c) **On small fields** where the length of the terrace does not exceed 400 feet.

Note—In spacing level terraces it is advisable to reduce the vertical spacing one foot making the spacing one foot less than the (V.S.) figures given in Table No. 1—Rule 3.

3—Erosion: The foregoing terracing recommendations apply to the control of both **sheet erosion** and **gullying.** The best time to control erosion is to check it before it damages the field or farm. Terraces may cross small gullies providing the low place is built up with an earth embankment sufficiently strong to withstand heavy rains. **Large gullies** (Figure 2) may be reclaimed by using soil saving dams (Figure 13).

4—Soil saving dams are dams built across large gullies at intervals to hold soil, but permit water to pass off. They are built of concrete (Figure 13), stone, timber, wire, brush or trees. As many gullies as possible, economically, should be reclaimed by using the soil saving dam. The common tendency is to use all large gullies for **terrace outlets.** Frequently this practice causes a material waste of land, labor and money. One should eliminate all gullies not required for natural drainage. The remaining gullies should be protected by using soil saving dams.

5—Terracing aims to control erosion on farm lands, eliminate gullies and make larger fields. Large fields are desirable for they may be worked with improved machinery at a saving of labor and time.

6—Terracing levels have complete instructions accompanying them. Study the instructions and learn how to set up, level and adjust the instrument before attempting to follow these terracing instructions.

7—Progress: North Carolina has made rapid progress in terracing in the last forty years. The Mangum Terrace was developed near Raleigh and its use spread over not only North Carolina, but also the whole South.

The time has come when every acre of North Carolina farm lands which has a tendency toward erosion should be well terraced. Cut over and barren or idle farm lands should be developed into permanent pastures and forests.

The policy of the Agricultural Extension Service is to control erosion by teaching farmers and farm boys how to terrace their lands. Terracing schools offer this instruction.

TERRACING SCHOOLS

Farmers desiring more definite instruction than given in this circular may attend the Terracing Schools.

Terracing schools are conducted by the County Agent and Agricultural Engineer. Their object is to teach both the fundamentals of terracing and the approved practices used in locating and building terraces.

The school requires two days' time during which terraces are located and built on a farm where erosion is a serious problem. Every farmer has the opportunity of learning the use of a farm level in locating terraces.

County Agents make the arrangements for conducting terracing schools. Requests for terracing schools should be made to the County Agent.